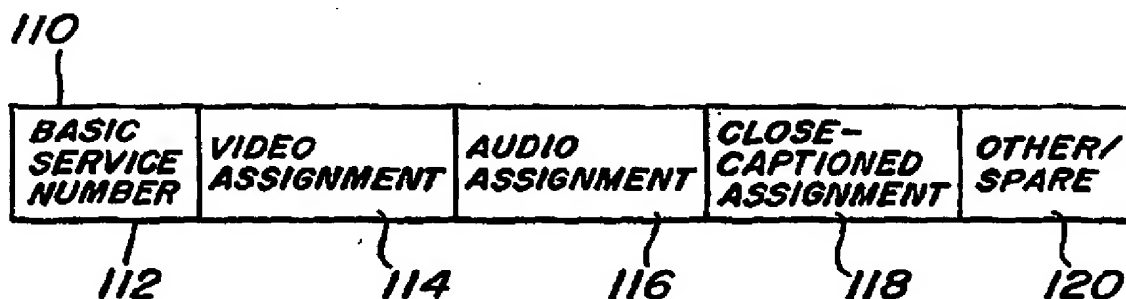




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(54) Title: **METHODS AND APPARATUS FOR PROVIDING VIRTUAL SERVICE SELECTION IN A MULTI-SERVICE COMMUNICATIONS SYSTEM**



(57) Abstract

Methods and apparatus are disclosed for providing program selection in a packet-based communications system. A program definition (110) is generated for each program (BS<sup>1</sup>, BS<sup>2</sup>, ...BS<sup>n</sup>) that specifies which of the elementary streams carried on a particular frequency channel comprise that program. The program definition for each program is periodically, and frequently, transmitted to each subscriber location (72, 74) on the frequency channel carrying the elementary streams of the selected program, extracts a program definition for the selected program from the tuned frequency channel, and then obtains from the frequency channel the elementary streams (V, A, CC) specified in the extracted program definition as comprising the selected program.

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METHODS AND APPARATUS FOR PROVIDING VIRTUAL SERVICE  
SELECTION IN A MULTI-SERVICE COMMUNICATIONS SYSTEM

BACKGROUND OF THE INVENTION

Field of the Invention

5           The present invention generally relates to multi-service communications systems wherein a plurality of different services are transmitted to subscriber locations over one or more different frequency channels. More particularly, the present invention relates to methods and  
10 apparatus for providing virtual service selection in such multi-service communications systems.

Description of the Prior Art

Communications systems today have the ability to simultaneously transmit a multitude of video, audio, teletext  
15 and data services to subscribers. For example, with the advent of digital compression technologies, the subscription television industry has experienced an explosion in the number of services that can be provided to each subscriber. Consequently, subscribers face an overwhelming choice of  
20 available services, and providing efficient and inventive ways for subscribers to access these services is extremely important.

Most multi-service communications systems transmit different services over one or more different frequency  
25 channels. Each frequency channel may carry more than one service. Accessing a particular service requires tuning to the frequency channel carrying that service, and then selecting that service from the many services carried on that

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frequency channel. Generally, it is desirable to insulate subscribers from the details of service access and to allow subscribers to access different services in a like manner. Subscription television operators typically assign each  
5 service a unique number and then provide subscribers with a decoder that allows the subscriber to access a particular service by selecting that service's number using a push-button device or hand-held remote. Subscribers are thereby insulated from the complex details of service acquisition.

10 Additionally, it is desirable to provide system operators with the ability to easily re-assign service numbers to different services. Some services may be discontinued and others may be added, and therefore, a static numbering system rapidly becomes obsolete. Bennett et al.,  
15 U.S. Patent No. 4,908,859, and Yoneda et al., U.S. Patent No. 5,200,823, both describe multi-service communications systems that provide system operators with a degree of flexibility in channel number assignment. Both systems employ a scheme sometimes referred to as "virtual channel mapping" in which a  
20 "channel map" is employed to map each available service to a different subscriber selectable channel number. In both systems, the channel map is stored in the user's decoder and contains an entry for each user selectable channel number. When a user selects a given service number for viewing, the  
25 decoder accesses the channel map entry for that channel number to determine which of the services being received by the decoder corresponds to the selected channel number. When the appropriate service is identified, the decoder tunes to the appropriate frequency and retrieves the selected service  
30 from the incoming data on that frequency channel. A system operator can alter the channel number assignments by modifying the appropriate channel map entries. Both systems allow a system operator to transmit new channel map entries to the decoder over one or more of the frequency channels.  
35 However, in each system, the entire channel map is stored in a memory in the decoder at all times. Unfortunately, with the ever increasing number of available services, the amount

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of memory required to store an entire channel map can become prohibitive. Consequently, there is a need for a method and apparatus that provides virtual service selection in a multi-service communications system without the need to store the entire channel map in the decoder. The present invention satisfies this need.

#### SUMMARY OF THE INVENTION

One aspect of the present invention is directed to a method for enabling a subscriber to access different basic services in a multi-service communications system wherein each of the different basic services comprises a plurality of service components and the service components of each basic service are received at the subscriber location in a multiplexed form on one of a plurality of frequency channels. Some frequency channels may contain multiplexed service components for more than one basic service. As described herein, the method comprises the steps of (a) generating a virtual service definition for each basic service that specifies which of the service components carried on a particular frequency channel comprise that service; and (b) periodically transmitting the virtual service definition for each basic service to the subscriber location on the frequency channel carrying the service components that comprise that basic service. A decoder at the subscriber location may tune to the frequency channel carrying the service components of a selected basic service, extract from the tuned frequency channel one of the virtual service definitions transmitted thereon for the selected basic service, and then obtain from the frequency channel the service components specified in the extracted virtual service definition. Preferably, a unique virtual service number is assigned to each basic service, and the virtual service definition for each basic service comprises a virtual service number designation and at least one service component assignment.

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At a subscriber location, a method for accessing the service components of a selected basic service comprises the steps of (a) tuning to the frequency channel carrying the service components of the selected basic service; (b) extracting from the tuned frequency channel one of the virtual service definitions transmitted thereon for the selected basic service; and (c) obtaining from the tuned frequency channel the service components specified in the extracted virtual channel definition as comprising the selected basic service. Preferably, a tuning map is provided at the subscriber location that specifies, for each basic service, which of the frequency channels carries the multiplexed service components that comprise that basic service. When such a tuning map is provided, the step of tuning to the frequency channel carrying the service components of the selected basic service comprises (i) accessing the tuning map to determine which of the frequency channels carries the multiplexed service components of the selected basic service; and (ii) tuning to the frequency channel specified in the tuning map for that basic service.

Another aspect of the present invention is directed to an apparatus for providing virtual service selection at a subscriber location in a multi-service communications system. According to the present invention, the apparatus comprises means for generating a virtual service definition for each basic service that specifies which service components carried on a particular frequency channel comprise that basic service; and means for periodically transmitting to the subscriber location the virtual service definition for each basic service. Preferably, the virtual service definitions for a given basic service are transmitted to the subscriber location only on the frequency channel carrying the service components that comprise that basic service.

A decoder apparatus for use in such a system comprises a service selection switch for selecting one of the basic services for output at the subscriber location; means for tuning to the frequency channel carrying the multiplexed

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service components of the selected basic service and for receiving the multiplexed service components carried on that frequency channel; means for extracting from the tuned frequency channel one of the virtual service definitions transmitted thereon for the selected basic service; and a de-multiplexer coupled to the receiving means and responsive to the extracted virtual service definition for de-multiplexing the received multiplexed service components and for obtaining the service components specified in the extracted virtual service definition as comprising the selected basic service. Preferably, the means for tuning and receiving comprises a tuning map that specifies, for each basic service, which of the frequency channels carries the multiplexed service components that comprise that basic service; and a tunable receiver responsive to the tuning map for tuning to a frequency channel specified by the tuning map.

As described hereinafter, the present invention may be embodied in a multi-service communications system that operates in accordance with the MPEG-2 Systems standard, wherein each basic service defines a "program", and each virtual service definition defines a "program definition" in accordance with the standard. Additional features and details of the present invention will become evident hereinafter.

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BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing summary, as well as the following detailed description of the preferred embodiments, is better understood when read in conjunction with the appended  
5 drawings. For the purpose of illustrating the invention, there is shown in the drawings embodiments that are presently preferred, it being understood, however, that the invention is not limited to the specific methods and instrumentalities disclosed. In the drawings:

10 Figure 1 is a block diagram of an exemplary subscription television system in which the method and apparatus of the present invention may be embodied;

Figure 2 graphically illustrates the content and arrangement of an exemplary digital data stream comprising  
15 system data and a plurality of multiplexed service components;

Figure 3 illustrates further details of the content and arrangement of the exemplary data stream of Figure 2;

Figure 4 is a block diagram providing further  
20 details of the exemplary subscription television system of Figure 1;

Figure 5 illustrates the general arrangement and contents of an exemplary service-to-component map definition in accordance with one embodiment of the present invention;

25 Figure 6 is a block diagram of one embodiment of an apparatus for providing virtual service selection in a multi-service communications system in accordance with the present invention;

Figure 7 illustrates the general arrangement and  
30 contents of an exemplary tuning map in accordance with one embodiment of the present invention;

Figure 8 is a flow diagram illustrating both the operation of the apparatus of Figure 6 and one embodiment of the method of the present invention; and

35 Figure 9 graphically illustrates the mapping functions of the apparatus of Figure 6.



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DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Before proceeding to the description of the drawings, it should be understood that, although the present invention is described herein as embodied in a CATV or  
5 subscription television system, the present invention is in no way limited thereto. Rather, the present invention may be employed in any multi-service communications system in which virtual service selection is required.

Referring now to the drawings wherein like numerals  
10 indicate like elements throughout, Figure 1 shows a partial block diagram of an exemplary subscription television system 10 in which the methods and apparatus of the present invention may be embodied. As used herein, the term "subscriber" means any person or location that receives basic  
15 services transmitted in the system. In the context of the subscription television system of Figure 1, the term "subscriber" typically applies to each individual who subscribes to the subscription television service being provided. As shown in Figure 1, the system 10 comprises a  
20 plurality of encoders 18 each of which is operated by a "programmer", e.g. 12, 14 and 16. Any number of programmers may be present in the system 10. Programmers are entities that provide one or more basic services (e.g.,  $BS_1..BS_N$ ) for transmission to various subscribers. For example, in Figure  
25 1, programmer 12 is providing basic services  $BS_1, BS_2..BS_N$ . The number of basic service provided by a given programmer is limited only by available bandwidth. In subscription television systems, basic services are most often television programs, however, any type of service can be transmitted.  
30 For example, a basic service can be a digital audio service or a teletext service.

Each basic service comprises a set of related service components, such as video (V), audio (A) and closed-captioning (CC) service components, as shown. In the present  
35 embodiment, the service components comprise digital data, however, the present invention is not limited thereto and may also be employed in systems that transmit analog service

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components or a combination of digital and analog service components. Moreover, one or more service components of a given basic service may be compressed and/or encrypted prior to transmission.

5           At each programmer site 12, 14, 16, the service components (i.e., V, A, CC) of the basic services ( $BS_1$ ,  $BS_2$  ..  $BS_N$ ) to be transmitted from that site are provided to an encoder 18 at that site. The encoder 18 multiplexes the service components of each basic service to generate a  
10 multiplexed data stream containing the multiplexed service components and, as explained hereinafter, various other system related data, some of which may be necessary for operation of the methods and apparatus of the present invention. Each programmer 12, 14, 16 then provides its  
15 multiplexed data stream (e.g.  $DS_1$ ,  $DS_2$  ..  $DS_N$ ) to a respective satellite up-link 20 for transmission via satellite 30 to a remote location, such as a head-end installation or a direct-broadcast-satellite (DBS) subscriber. Typically, each programmer transmits its respective data stream over a  
20 different satellite transponder. Each transponder operates at a different transponder frequency.

Each encoder 18 in the exemplary subscription television system 10 of Figure 1 may generate its respective multiplexed data stream in accordance with the exemplary  
25 frame-based multiplexing format illustrated in Figure 2. It is understood, however, that any multiplexing format may be employed by the encoders 18. For example, as explained hereinafter, each encoder 18 may alternatively operate in accordance with the MPEG-2 Systems standard specified in the  
30 MPEG-2 Systems Committee Draft (ISO/IEC JTC1/SC29/WG11/N0601, November, 1993) [hereinafter "MPEG-2 Systems Committee Draft"], which is hereby incorporated by reference.

As shown in Figure 2, the exemplary frame-based multiplex format comprises a continuous sequence of frames  
35 28. A system data region 32 of each frame may contain system related information necessary for operation of the system 10. A service component data region 34 of each frame carries the

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5 multiplexed service components of the various basic services input to the encoder 18. As described hereinafter in greater detail, the system data may include information employed in accordance with the method and apparatus of the present invention. Because certain types of system data may be too numerous to transmit in a single frame, these types of data may be spread over a series of frames referred to herein as a "cryptocycle." According to the example shown in Figure 2, a cryptocycle comprises eight (8) frames; however, a  
10 cryptocycle can be defined by any number of frames. Essentially, cryptocycles define fixed boundaries in the data stream 26 within which a complete set of system data is transmitted.

Figure 3 illustrates in greater detail the general  
15 arrangement and structure of a single frame 28 of the exemplary data stream format of Figure 2. As shown, each frame begins with a frame sync word (FSYNC) 42, and each line of the frame may begin with a horizontal sync word (HSYNC) 50. Each line may comprise a fixed number of bits, such as  
20 1600 bits. Decoders in the system may employ the HSYNC and FSYNC words to establish frame synchronization after receiving the data stream. For purposes described hereinafter, and in accordance with the present invention, the system data region 32 of each frame 28 may carry tuning map entries 44 and service-to-component map definitions 46. As explained in related U.S. application serial no. 08/027,782, now U.S. Patent No. 5,359,601, the system data region of each frame may also carry dynamic virtual service map definitions in accordance with a dynamic virtual service  
30 selection feature described therein which provides system operators with the ability to define new services (i.e., dynamic virtual services) using time-varying groups of basic services. Other system related information may also be carried. As explained above, the multiplexed service  
35 components of each basic service are carried in region 34 of each frame 28. Preferably, the service components of the various basic service are multiplexed by allocating different

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portions of region 34 of each successive frame to different ones of the service components. An exemplary method of multiplexing the individual service components and an exemplary implementation of each encoder 18 are described in related U.S. patent application Serial No. 07/968,846. As mentioned above, however, the particular implementation of each encoder 18 and the particular arrangement and format of the multiplexed data stream generated by each encoder are not crucial to the present invention. Rather the present invention is applicable to any communications system wherein individual service components are multiplexed and transmitted to a remote location. For example, as explained in greater detail below, the methods and apparatus of the present invention may be embodied in a system that multiplexes and transmits service components in accordance with the MPEG-2 Systems standard (ISO 13818) set forth in the aforementioned MPEG-2 Systems Committee Draft.

Figure 4 illustrates further details of the exemplary subscription television system 10 of Figure 1. In particular, Figure 4 shows a block diagram of a cable head-end installation 52 and a plurality of subscriber locations, e.g. 72, 74. As shown, the multiplexed data streams (i.e.,  $DS_1, DS_2 \dots DS_N$ ), which each contain the service components of a number of basic service, are acquired at the head-end 52 via satellite down-link 54 and provided to respective receivers 56, 58, 60. Each receiver 56, 58, 60 is tuned to a respective satellite transponder frequency for receiving the data stream carried over that transponder. After receipt at the head-end 52, each data stream is then provided to a respective modulator 62, 64 or 66 where it is modulated on a unique frequency channel. Each frequency channel typically has a bandwidth of 6 MHz, however, the bandwidth of each frequency channel may vary with different applications. Modulators 62, 64 and 66 preferably employ 64-QAM (quadrature amplitude modulation). Alternatively, modulators 62, 64 and 66 may employ 4-VSB (vestigial side-band) modulation or any other suitable modulation technique. As shown, the

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individual frequency channels are then provided to a combiner 68 that combines the frequency channels into a single wide-band signal that is then transmitted via a cable distribution network 70 to each of the subscriber locations 72, 74. As  
5 can be appreciated, therefore, the service components of each basic service are provided to each subscriber location, in multiplexed form, on one of the plurality of frequency channels. As explained above, each multiplexed data stream  $DS_1, DS_2 \dots DS_N$ , and therefore each frequency channel,  
10 typically will carry the multiplexed service components of a number of basic services. As described hereinafter, a decoder 76 is provided at each subscriber location 72, 74 to enable the subscriber at that location to access different ones of the basic services in accordance with the present  
15 invention. In a subscription television system, the basic services are most often television programs or audio programs that are output on a television set 78 and/or audio output device 80 at the subscriber location.

For the purpose of providing virtual service  
20 selection at subscriber locations, each basic service transmitted to the subscribers is assigned a unique virtual service number. Assignment of virtual service numbers to each basic service is completely arbitrary and will usually be performed by the operator(s) of the communications system.  
25 For example, in a subscription television system, service number "14" could be assigned to a particular pay-television service, service number "6" could be assigned to a network broadcast, and so on. Subscribers are typically provided with a "program guide" that lists each available service by  
30 its assigned virtual service number. Alternatively, graphical user interfaces may be provided in which the user is able to select a basic service by the service's name, rather than by its assigned virtual service number. Essentially, the graphical user interface would "hide" from  
35 the subscriber the association between the displayed service name and its assigned virtual service number. As used herein and in related U.S. patent application serial no. 07/027,782,

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now U.S. Patent No. 5,359,601, the terms "service number", "basic service number", "virtual service number" and "virtual channel number" are equivalent.

In any virtual service selection scheme, virtual  
5 service definitions are used to associate the virtual service numbers assigned to each basic service to the transmitted service components that "make up" each basic service. As used herein and in related U.S. patent application serial no. 08/027,782, now U.S. Patent No. 5,359,601, the terms "virtual  
10 service definition" and "service-to-component map definition" are synonymous. Virtual service definitions, or service-to-component map definitions, are sometimes also referred to as "virtual channel definitions".

At least one virtual service definition (i.e.,  
15 service-to-component map definition) is required for each basic service. Figure 5 illustrates the general arrangement and contents of one embodiment of a virtual service definition 110 for a given basic service. In particular, the virtual service definition 110 shown in Figure 5 may be  
20 employed to facilitate virtual service selection in a subscription television system employing the frame-based multiplexing format illustrated in Figures 2 and 3. As shown, the definition 110 comprises a virtual service number designation 112 that specifies the virtual service number  
25 assigned to the particular basic service being defined. The virtual service number designation 112 is followed by one or more service component assignments 114..120. Each of the service component assignments 114..120 identifies a different one of the service components that collectively comprise the  
30 basic service being defined. For example, in a subscription television system, a basic service is typically a television program which may consist of an audio service component, a video service component and possibly a closed-captioning service component. Accordingly, the virtual service  
35 definition for that basic service must identify which video, audio and closed-captioning service components make-up that particular basic service.

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As explained above, in the prior art, the virtual service definitions for every subscriber selectable basic service are stored in a memory in the decoder, and are sometimes collectively referred to as a "virtual service map", "service-to-component map", "channel map", "virtual channel map" or "virtual service map". In the prior art, when a subscriber selects a given virtual service number for viewing, etc., the decoder must access the virtual service definitions in the stored "channel map" to determine which multiplexed service components received by the decoder are associated with the basic service assigned that virtual service number. Essentially, the decoder accesses the stored "channel map" and retrieves the virtual service definition whose virtual service number field (e.g. field 112 of the exemplary definition of Figure 5) matches the virtual service number selected by the subscriber. Once tuned to the appropriate frequency channel, the decoder retrieves the service components (e.g., audio and video signals) specified in the virtual service definition from the incoming data on that frequency channel.

Unfortunately, with an ever increasing number of available services, the cost of memory required to store an entire "channel map" in the decoder can become prohibitive. According to the present invention, therefore, the virtual service definitions for every basic service are not stored in the subscriber's decoder. Rather, as explained hereinafter in greater detail, the virtual service definition for each basic service is periodically, and frequently, re-transmitted to the subscriber's decoder on the frequency channel carrying the service components of that basic service. All that is stored in the decoder is a tuning map that identifies which frequency channel carries the multiplexed service components of the selected service, however, even the tuning map may be periodically and frequently retransmitted to the decoder to avoid the need to store it in the decoder. A tunable receiver in the decoder tunes to the appropriate frequency channel specified in the tuning map as carrying the service

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components of the selected basic service. Once the receiver tunes to the specified frequency channel, which typically will carry the service components of several different basic services, the decoder must extract one of the virtual service  
5 definitions for the selected service from the incoming data stream. A demultiplexer in the decoder then uses the service component assignment information in the extracted virtual service definition to identify and retrieve the service components of the selected basic service from the incoming  
10 multiplexed data stream on the tuned frequency channel.

In a subscription television system such as that illustrated in Figures 1 and 4, the virtual service definitions for each basic service may be generated by the encoders 18 and inserted into the respective multiplexed data  
15 streams at each programmer site 12, 14, 16. According to the present invention, each encoder 18 generates the virtual service definitions for the basic services carried in the multiplexed data stream generated by that encoder 18.

Alternatively, the virtual service definitions for each basic  
20 service can be inserted into their respective multiplexed data streams by the operator of the cable head-end installation 52 shown in Figure 4.

When the exemplary frame-based multiplexing format of Figures 2 and 3 is employed, the virtual service  
25 definitions may be inserted into the system data region 32 of one or more frames 28 of a given multiplexed data stream 26. Preferably, the virtual service definitions for each basic service carried in a given multiplexed data stream are inserted into the data stream, and therefore transmitted,  
30 once every cryptocycle. Frequent re-transmission of each virtual service definition allows the decoder to quickly acquire the appropriate definition whenever the subscriber selects a new virtual service number (i.e., changes channels).

35 As explained above, in the exemplary subscription television system of Figures 1 and 4, each multiplexed data stream generated by a respective encoder 18 is modulated at



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the cable head-end 52 on a unique 6 MHz frequency channel. Thus, each frequency channel carries, in its respective multiplexed data stream, the multiplexed service components of one or more basic services. And, in accordance with the present invention, the virtual service definitions for each basic service are periodically (and frequently) retransmitted on the frequency channel carrying the service components of that basic service. In a preferred embodiment, each frequency channel only carries the virtual service definitions for the services carried on that frequency channel, and therefore, transmission bandwidth is conserved. Additionally, because the virtual service definitions are periodically and frequently retransmitted to the decoder, the decoder does not have to store an entire service-to-component map (i.e., channel map) in a memory in the decoder.

Figure 6 is a block diagram of one embodiment of an apparatus 82 for providing virtual service selection in a multi-service communications system in accordance with the present invention. In particular, apparatus 82 of Figure 6 may be employed as the decoder 76 at each subscriber location in a subscription television system (e.g. system 10 of Figures 1-4) when the system employs the frame-based multiplexed data stream format illustrated in Figures 2 and 3. According to the present embodiment, the apparatus 82 comprises a service selection switch 90 for selecting one of the available basic services, using its assigned virtual service number (i.e., virtual channel number), for output on a television set 78 and/or audio output device 80 at the subscriber location. The service selection switch 90 may comprise a push-button device wherein each button corresponds to a different virtual service number. Alternatively, the service selection switch 90 may comprise a hand-held remote-control wherein the selected service number appears on an LED display on the apparatus 82. Still further, the service selection switch 90 may comprise a graphical user interface displayed on a computer or television screen at the subscriber location.

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Apparatus 82 further comprises a tuning map 92 which specifies, for each basic service, which of the frequency channels carries the service components that "make-up" that basic service. According to the present embodiment, the tuning map 92 is stored in a memory in the apparatus 82. However, the tuning map 92 may be modified by transmitting modified tuning map entries to the apparatus 82. In the present embodiment, tuning map information may be transmitted as system data (see, e.g., Figure 3) on one or more of the frequency channels when required. An exemplary tuning map 92 is illustrated in Figure 8. As shown, the tuning map 92 comprises an entry for each basic service (identified by its virtual service no.) available to a subscriber. For each basic service, the tuning map 92 specifies the frequency channel (e.g.,  $f_1$ ,  $f_2$ , etc.) that carries the multiplexed service components for that basic service. For example, according to the tuning map 92 shown, the service components of basic service no. "24" are carried on frequency channel  $f_2$ , the service components of basic service no. "3" are carried on frequency channel  $f_3$ , and so on.

When a subscriber selects a given basic service, the virtual service number for that service is provided by the service selection switch to the tuning map 92 via line 93. The tuning map 92 then provides the appropriate frequency index,  $f_x$ , to a tunable receiver 98 which tunes to that frequency channel. Once tuned to the appropriate frequency channel, the receiver begins receiving the multiplexed service components and system data, which in the present embodiment are carried on that frequency channel in the frame-based multiplexed data stream format illustrated in Figures 2 and 3.

Apparatus 82 further comprises a system data processor 100 coupled to the receiver 98 for receiving the incoming multiplexed service components and system data. In the present embodiment, wherein the system data and multiplexed service components are transmitted in the frame-based data stream format illustrated in Figures 2 and 3, the

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processor 100 may employ the HSYNC and FSYNC words to establish frame synchronization to facilitate extraction of the system data from each frame. Also in the present embodiment, the system data processor 100 is coupled to the  
5 service selection switch 90 for receiving the virtual service number of the basic service currently selected by the subscriber. According to the present embodiment, the system data processor 100 employs the selected virtual service number to extract one of the virtual service definitions for  
10 the selected basic service from the incoming system data on the received frequency channel. To this end, the system data processor 100 may compare the subscriber selected virtual service number with each incoming virtual service definition until it finds a definition whose virtual service number  
15 designation matches the selected virtual service number. Once extracted, the virtual service definition is provided to a temporary virtual service definition store 94 (referred to in related U.S. patent application Serial No. 08/027,782, now U.S. Patent No. 5,359,601, as "service-to-component map 94").  
20 The virtual service definitions for all other basic services carried on the received frequency channel are simply ignored.

As an alternative, the system data processor 100 may extract the virtual service definitions for each of the basic services carried on the received frequency channel  
25 (only) and then provide each of those definitions to storage memory 94. In such an embodiment, the virtual service number of the selected basic service may then be provided by the service selection switch 90 directly to memory 94 (via dashed-line 63, for example) as an index thereto in order to  
30 retrieve the definition for the selected service. While such an embodiment would require additional memory, the amount of memory required would still be significantly less than that required in prior art systems in which the virtual service definitions for every basic service on every frequency  
35 channel are stored in the decoder.

Referring still to Figure 6, the system data processor 100 passes the multiplexed service components

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received on the tuned frequency channel to a service component demultiplexer 102. The service component demultiplexer 102 is responsive to the virtual service definition of the selected service, which has been stored in memory 94, for de-multiplexing the received multiplexed service components and obtaining therefrom the service components specified in the extracted virtual channel definition as comprising the selected basic service. Video related service components of the selected service (e.g., video, closed-captioning, teletext, etc.) may be output to a video processor 104 and then displayed on a television set 78. Audio service components of the selected basic service may be output to an audio processor 106 and then provided to an audio output device, such as a speaker system 80.

Exemplary implementations of system data processor 100 and a service component demultiplexer 102 may be found in the aforementioned related U.S. patent application Serial No. 07/968,846. Again, however, the particular implementations of the processor 100 and de-multiplexer 102 are not crucial to the present invention and will depend, in large part, upon the particular data stream format employed in the multi-service communications system.

In operation, a subscriber selects one of the basic services via the service selection switch 90, using its assigned virtual service number. Switch 90 provides the virtual service number of the selected basic service to the tuning map 92 which prompts the tunable receiver 98 to immediately tune to the frequency channel specified in the tuning map 92 for that service number. Switch 90 also provides the virtual service number of the selected basic service to the system data processor 100. Once the system data processor 100 begins receiving the incoming data from the tuned frequency channel, the processor uses the selected service number to extract one of the virtual service definitions for the selected service from the incoming data on the tuned frequency channel. The multiplexed service component data received on the tuned frequency channel is

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passed to the service component de-multiplexer 102. De-multiplexer 102 receives the extracted virtual service definition from the storage memory 94 and employs the information specified therein to de-multiplex the incoming  
5 service component data and to extract therefrom the service components of the selected basic service. Once the service components for the selected basic service have been obtained, video related services may be provided to a video processor 104, and audio related services may be provided to an audio  
10 processor 106. As explained above, the present invention is by no means limited to audio and video related service components. For example, a service component may be comprised of computer related data that may then be output on a computer system (not shown) at the subscriber location. As  
15 stated above, the present invention may be employed in any multi-service communications system.

Figure 8 is a flow diagram illustrating both the operation of the apparatus of Figure 6 and one embodiment of the method of the present invention. As shown, at step 130,  
20 a subscriber's service selection is obtained via the service selection switch 90. Next, at step 132, the frequency channel carrying the service components of the selected service is identified via the tuning map 92, and the apparatus then "tunes" to that frequency channel. Once tuned  
25 to the appropriate frequency channel, one of the virtual service definitions for the selected service is extracted from the received frequency channel at step 136. As explained above, when the frame-based multiplexing format illustrated in Figures 2 and 3 is employed, the virtual  
30 service definition for the selected service is extracted from the system data region of one or more incoming frames of the multiplexed data stream carried on the tuned frequency channel. The virtual service definition for the selected service specifies which service components carried on the  
35 tuned frequency channel "make-up" the selected service. For example, if the selected service is a television program, the virtual service definition for that service will typically

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identify a video service component and a related audio service component that together "make-up" that television program. Additionally, if the selected television program is closed-captioned for the hearing impaired, the virtual  
5 service definition may also specify a closed-caption service component that contains the appropriate closed-captioning data for that television program.

Once the virtual service definition for the selected program has been extracted from the incoming data on  
10 the tuned frequency channel, control passes to step 136 wherein the incoming multiplexed service components carried on the received frequency channel are de-multiplexed. Using the service component assignments specified in the virtual service definition for the selected service, the apparatus 82  
15 (i.e., demultiplexer 102) is able to identify and retrieve the service components that comprise the selected service and to provide those service components to suitable output devices, as indicated at step 138. For example, the audio service component (i.e., the audio data or signal) of a  
20 selected basic service will be provided to a suitable audio output device, such as, for example, the audio output device 80 shown in Figure 6. Similarly, the video service component of a selected basic service will be output to a suitable display device, such as, for example, the television set 78  
25 of Figure 6. Unless a subscriber selects a different service (i.e., "changes channels"), the apparatus will remain at step 138 and continue to output the service components of the currently selected service. However, as shown at step 140, if the subscriber selects a different service, then control  
30 passes back to step 130.

If the newly selected service is also carried on the currently tuned frequency channel, the apparatus 82 will not have to "tune" to a different frequency channel at step 132. Rather, the apparatus will merely have to extract one  
35 of the virtual service definitions for the newly selected service at step 134. As explained, according to the present invention, the virtual service definition for each basic

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service is frequently retransmitted on the tuned frequency channel thereby enabling the apparatus to quickly acquire one of the definitions for the newly selected service. If the tuning map 92 indicates that the newly selected service is  
5 carried on a different frequency channel than the one currently being received, however, the apparatus must "re-tune" to the new frequency channel before proceeding to step 134.

Figure 9 graphically illustrates the mapping  
10 functions of the apparatus 82. For convenience of illustration only, the service selection numbers (i.e., "virtual service numbers") are illustrated twice in Figure 9; once to illustrate the tuning map 92 functionality and once to illustrate the mapping of virtual service numbers to their  
15 respective service components via the respective virtual service definitions. As explained above, each basic service is assigned a unique virtual service number by an operator of the communications system. In the present example, there are thirty-two basic services (e.g., basic service nos. 1 - 32).  
20 In other embodiments, however, the number of basic services may be different. Moreover, according to the present invention, although the virtual service definitions for each service collectively define a "virtual service map" (i.e., "service-to-component map"), the entire virtual service map  
25 is never stored in the apparatus 82. Rather, the virtual service definition for each basic service is periodically, and frequently, re-transmitted to the apparatus 82 on the frequency channel carrying the service components of that basic service so that a decoder can extract the necessary  
30 definitions when needed. For convenience of illustration, Figure 9 shows the virtual service definitions for every basic service.

As illustrated in Figure 9, and as explained above, the tuning map 92 identifies, for each basic service, which  
35 of the frequency channels carries the multiplexed service components of that basic service. Once the appropriate frequency channel is identified, the virtual service

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definition of a selected basic service (transmitted on that frequency channel along with the multiplexed service component data) specifies which multiplexed service components within that frequency channel "make-up" the  
5 selected basic service.

The foregoing embodiment of the present invention is fully described in related U.S. patent application serial no. 08/027,782, now U.S. Patent No. 5,359,601. Element numerals in Figures 1-10 of the present application  
10 correspond directly to like element numerals in the related U.S. application. That application, however, is more particularly directed to an additional service selection feature referred to therein as "dynamic" virtual service selection. Although the foregoing description illustrates  
15 one embodiment of the present invention, i.e., in a subscription television system employing a frame-based multiplexing scheme (Figures 2 and 3), the present invention is by no means limited thereto. Rather, the present invention may be employed in any multi-service communications  
20 system.

Recently, the International Organization for Standardization (ISO) adopted a standard format for multiplexing a plurality of digital services for transmission in a multi-service communications system. The standard, is  
25 set forth in detail in the MPEG-2 Systems Committee Draft (ISO/IEC JTC1/SC29/WG11/N0601, November, 1993) [hereinafter "MPEG-2 Systems Committee Draft"], which is hereby incorporated by reference. One section of the MPEG-2 Systems standard specifies a format (i.e., a syntax and a set of  
30 semantic rules) for multiplexing a number of digital signals to generate a multiplexed data stream, referred to therein as a "Transport Stream." Essentially, the MPEG-2 Transport Stream specification describes a packetized, as opposed to frame-based, multiplexing scheme. Although not limited to  
35 application in any one type of multi-service communications system, the MPEG-2 Systems standard is particularly well suited for transmission of digital video, audio and related



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data. Accordingly, as an alternative to the frame-based multiplexed data stream format illustrated in Figures 2 and 3, the MPEG-2 Systems standard may be implemented in the exemplary subscription television system 10 of Figures 1 and 4. In particular, the encoder 18 at each programmer site 12, 14, 16 may operate in accordance with the MPEG-2 Systems standard to multiplex the service components of the basic services input to that encoder for transmission to subscribers. Thus, rather than generate a multiplexed data stream having the frame-based format illustrated in Figures 2 and 3, each encoder 18 will generate a "Transport Stream" in accordance with the MPEG-2 Systems standard.

As used herein and in the MPEG-2 Systems Committee Draft, the terms "service component" and "elementary stream" are equivalent, as are the terms "basic service" and "program". According to the MPEG-2 Systems standard, the service components (i.e., elementary streams) that comprise a basic service (i.e., program) to be transmitted are each separately "packetized" to form a distinct "packetized elementary stream" (PES). For example, the video service component data for a given basic service would be packetized (i.e., consecutive portions of the service component data would be inserted into consecutive PES packets) to form one packetized elementary stream, and the audio service component data for that basic service would be packetized to form another packetized elementary stream. Each packetized elementary stream is assigned a unique Packet ID (PID). Each packetized elementary stream is then partitioned and inserted into the payload sections of a number of successive "transport packets". Every transport packet has a header, and each transport packet formed from a given packetized elementary stream contains the unique PID assigned to that elementary stream in its header. The individual transport packets formed from each elementary stream are then multiplexed in accordance with the MPEG-2 Systems standard to form a single bitstream, referred to therein as a "Transport

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Stream", comprised of a continuous sequence of transport packets.

Applicant and his Assignee are actively involved in the ISO standards process and proposed the present invention, as defined by the appended claims, for inclusion into the MPEG-2 Systems standard as a means for providing virtual service selection in multi-service communications systems that operate in accordance with the MPEG-2 Systems standard. Applicants' invention, as defined by the appended claims, has been adopted as part of the MPEG-2 Systems standard. For example, the MPEG Systems standard provides for a "Network Information Table" that is equivalent to the tuning map described above in that it specifies, for each basic service (program), which frequency channel (Transport Stream) carries the service components (elementary streams) that comprise that basic service. Additionally, according to the standard, a "program definition" for each basic service is periodically, and frequently, re-transmitted to the subscriber's decoder on the frequency channel (i.e., Transport Stream) carrying the service components of that basic service. A "program definition" associates a subscriber selectable "program number" with the service components that "make-up" the basic service (i.e., "program") assigned that program number. As in the claimed invention, once a decoder tunes to the frequency specified in the "Network Information Table", it must then extract the "program definition" for the basic service selected by the subscriber in order to determine which service components carried in the Transport Stream received on that frequency channel "make-up" the selected basic service.

As described in greater detail in the MPEG-2 Systems Committee Draft, the "program definition" for a subscriber selected basic service (i.e., "program") specifies the Packet ID's of each packetized elementary stream containing service component data associated with that selected program. Once the PID's have been identified, the decoder can simply extract every incoming packet having a PID

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that matches those specified in the program definition. In this manner, the service component data in each packetized elementary stream can be retrieved for output at the subscriber location. As used herein and in the MPEG-2

- 5 Systems Committee Draft, the terms "virtual service definition" and "program definition" describe equivalent elements, as do the terms "virtual service map" and "Program Map Table" and the terms "tuning map" and "Network Information Table". Accordingly, the appended claims are
- 10 intended to read on any multi-service communications system that implements a virtual service selection feature in accordance with the MPEG-2 Systems standard (ISO 13818) set forth in the aforementioned MPEG-2 Systems Committee Draft.

- Moreover, it is understood that changes may be made
- 15 to the embodiments described above without departing from the broad inventive concepts thereof. Accordingly, this invention is not limited to the particular embodiments disclosed, but is intended to cover all modifications that are within the scope and spirit of the invention as defined
- 20 by the appended claims.

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## WHAT IS CLAIMED IS:

1. A method for providing program selection at a subscriber location in a packet-based communications system wherein a plurality of programs are transmitted to the subscriber location and each of said programs comprises one or more elementary streams, the elementary streams of each of said programs being transmitted to the subscriber location in packets on one of a plurality of different frequency channels, said method comprising the steps of:
  - generating a program definition for each of said programs that specifies which of the elementary streams carried on a particular frequency channel comprise that program; and
  - periodically transmitting the program definition for each of said programs to the subscriber location on the frequency channel carrying the elementary streams that comprise that program;
  - whereby a decoder at the subscriber location tunes to the frequency channel carrying the elementary streams of a selected program, extracts from the tuned frequency channel one of the program definitions transmitted thereon for the selected program, and then obtains from the frequency channel the elementary streams specified in the extracted program definition.
2. A method according to claim 1 further comprising the step of assigning a unique program number to each of said programs, and wherein the program definition for each of said programs comprises a program number designation and at least one elementary stream assignment.
3. The method of claim 1 wherein said packet-based communications system operates in accordance with the MPEG-2 Systems standard (ISO 13818).

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4. In a packet-based communications system wherein a plurality of programs are transmitted to a subscriber location, and wherein each of said programs comprises a plurality of elementary streams, the elementary streams of each of said programs being received at the subscriber location in multiplexed packet form on one of a plurality of different frequency channels, some frequency channels containing the multiplexed elementary streams for more than one program, and further wherein program definitions are periodically transmitted to the subscriber location for each of said programs on the frequency channel carrying the elementary streams of that program, the program definitions for each of said programs specifying which elementary streams carried on the frequency channel comprise that program, a method of accessing the elementary streams of a subscriber selected program comprising the steps of:

tuning to the frequency channel carrying the elementary streams of the selected program;

extracting from the tuned frequency channel one of the program definitions transmitted thereon for the selected program; and

obtaining from the tuned frequency channel the elementary streams specified in the extracted program definition as comprising the selected program.

5. The method of claim 4 wherein each of said programs is assigned a unique program number, and wherein the program definition for each of said programs comprises a program number designation and at least one elementary stream assignment.

6. The method of claim 4 wherein said packet-based communications system operates in accordance with the MPEG-2 Systems standard (ISO 13818).

7. Apparatus for providing program selection at a subscriber location in a packet-based communications system

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of the type in which a plurality of programs are transmitted to the subscriber location and each of said programs comprises one or more elementary streams, the elementary streams of each of said programs being transmitted to the subscriber location in multiplexed packet form on one of a plurality of different frequency channels wherein some of said frequency channels carry the elementary streams of more than one of said programs, said apparatus comprising:

means for generating a program definition for each of said programs that specifies which elementary streams carried on a particular frequency channel comprise that program; and

means for periodically transmitting to the subscriber location the program definition for each of said programs, the program definition for a given program being transmitted to the subscriber location on the frequency channel carrying the elementary streams that comprise that program.

8. The apparatus recited in claim 7 further comprising a decoder for use at the subscriber location, said decoder comprising:

a service selection switch for selecting one of said programs for output at the subscriber location;

means for tuning to the frequency channel carrying the multiplexed elementary streams of a selected program and for receiving the multiplexed elementary streams carried on that frequency channel;

means for extracting from the tuned frequency channel one of the program definitions transmitted thereon for the selected program; and

a de-multiplexer coupled to said receiving means and responsive to the extracted program definition for de-multiplexing the received multiplexed elementary streams and for obtaining the elementary streams specified in the extracted program definition as comprising the selected program.

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9. The apparatus recited in claim 7 wherein said packet-based communications system operates in accordance with the MPEG-2 Systems standard (ISO 13818).

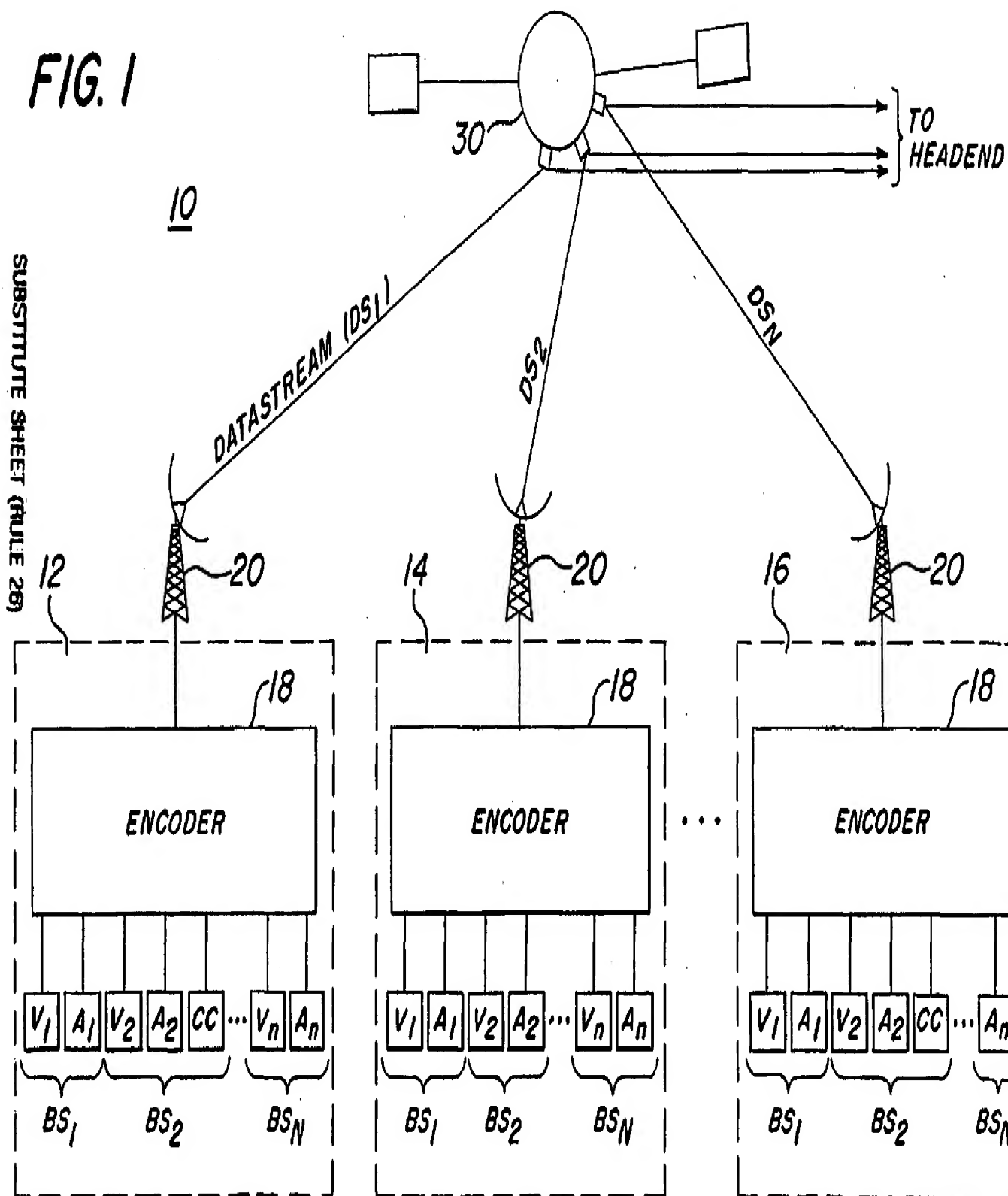
5           10. A decoder apparatus for providing program selection at a subscriber location in a packet-based communications system of the type in which a plurality of programs are transmitted to the subscriber location and each of said programs comprises a plurality of elementary streams,  
10 the elementary streams of each of said programs being receive at the subscriber location in multiplexed packet form or as a plurality of frequency channels, some frequency channels containing multiplexed elementary streams for more than one program, and further wherein a program  
15 definition for each of said programs is periodically transmitted to the subscriber location on the frequency channel carrying the elementary streams of that program, the program definition for a given program specifying which elementary streams carried on a particular frequency channel  
20 comprise that program, said decoder apparatus comprising:  
          a service selection switch for selecting one of said programs for output at the subscriber location;  
          means for tuning to the frequency channel carrying the multiplexed elementary streams of a selected program and  
25 for receiving the multiplexed elementary streams carried on that frequency channel;  
          means for extracting from the tuned frequency channel one of the program definitions transmitted thereon for the selected program; and  
30           a de-multiplexer coupled to said receiving means and responsive to the extracted program definition for de-multiplexing the received multiplexed elementary streams and for obtaining the elementary streams specified in the extracted program definition as comprising the selected  
35 program.

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11. The decoder apparatus recited in claim 10 wherein said packet-based communications system operates in accordance with the MPEG-2 Systems standard (ISO 13818).



**SUBSTITUTE SHEET (RULE 26)**



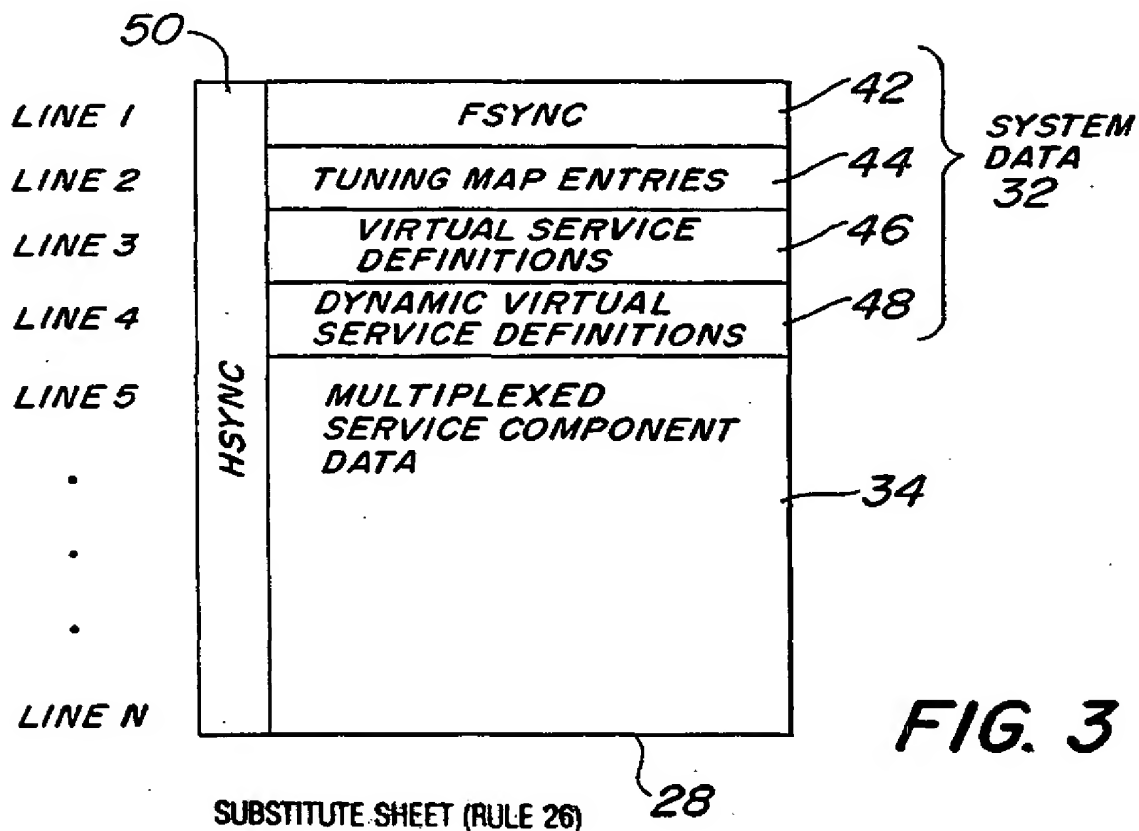
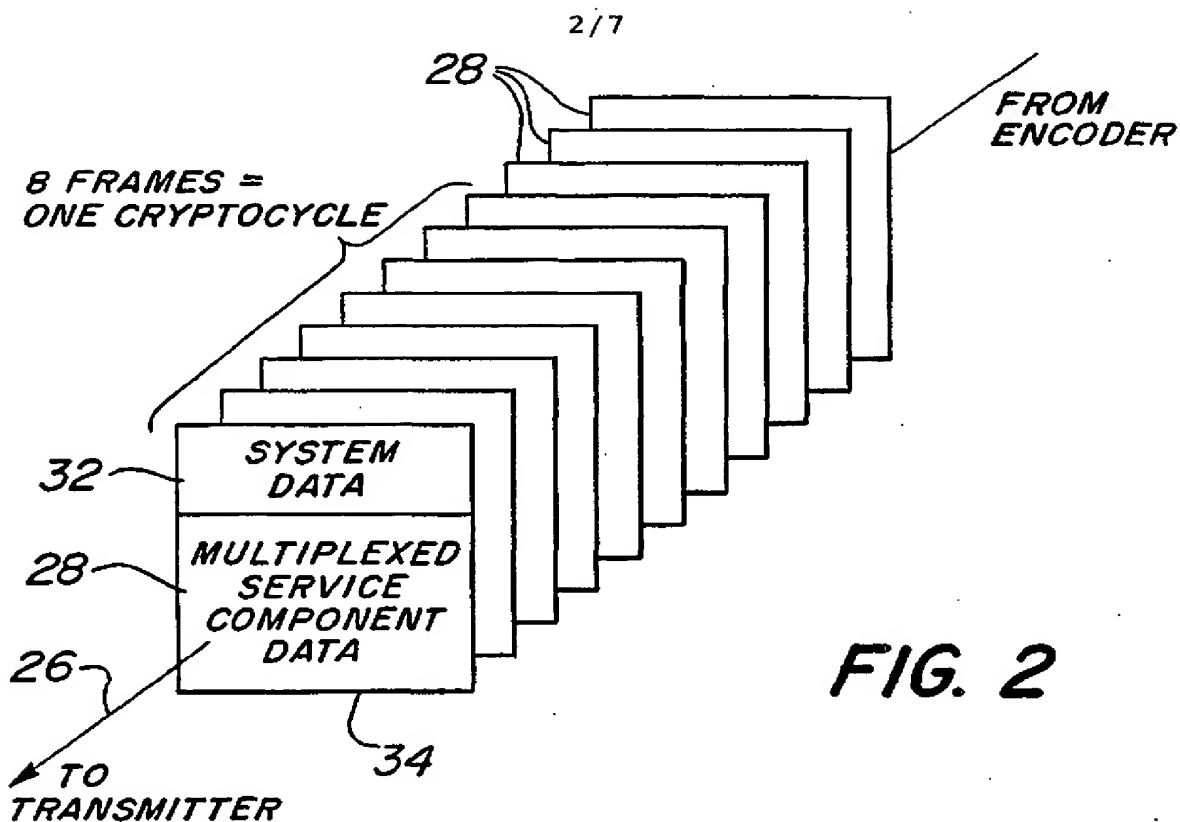
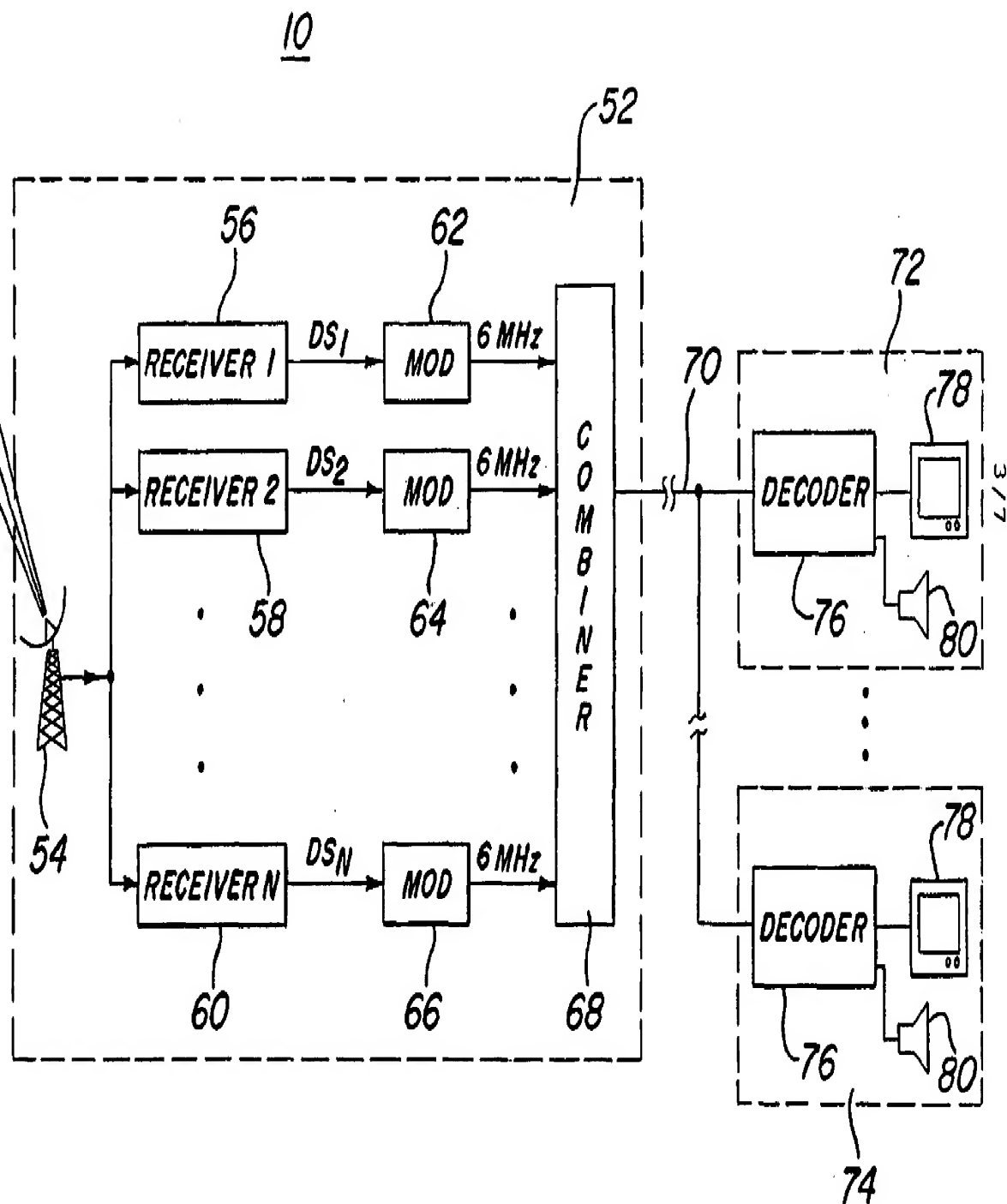


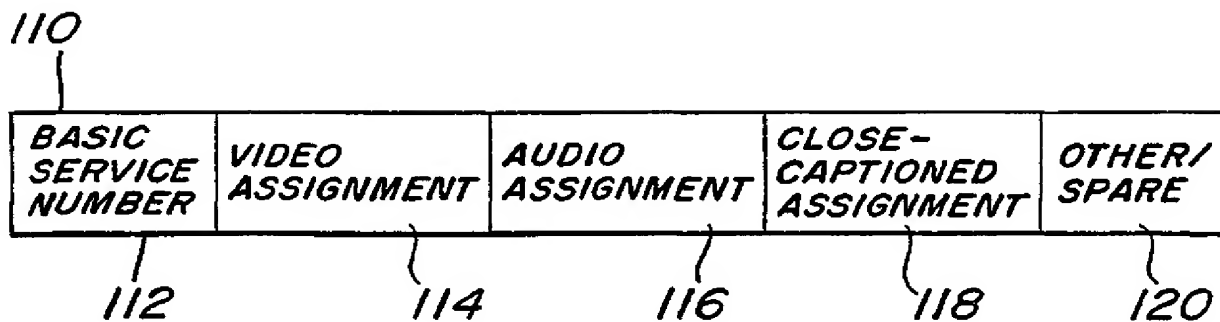
FIG. 4

FROM  
SATELLITE

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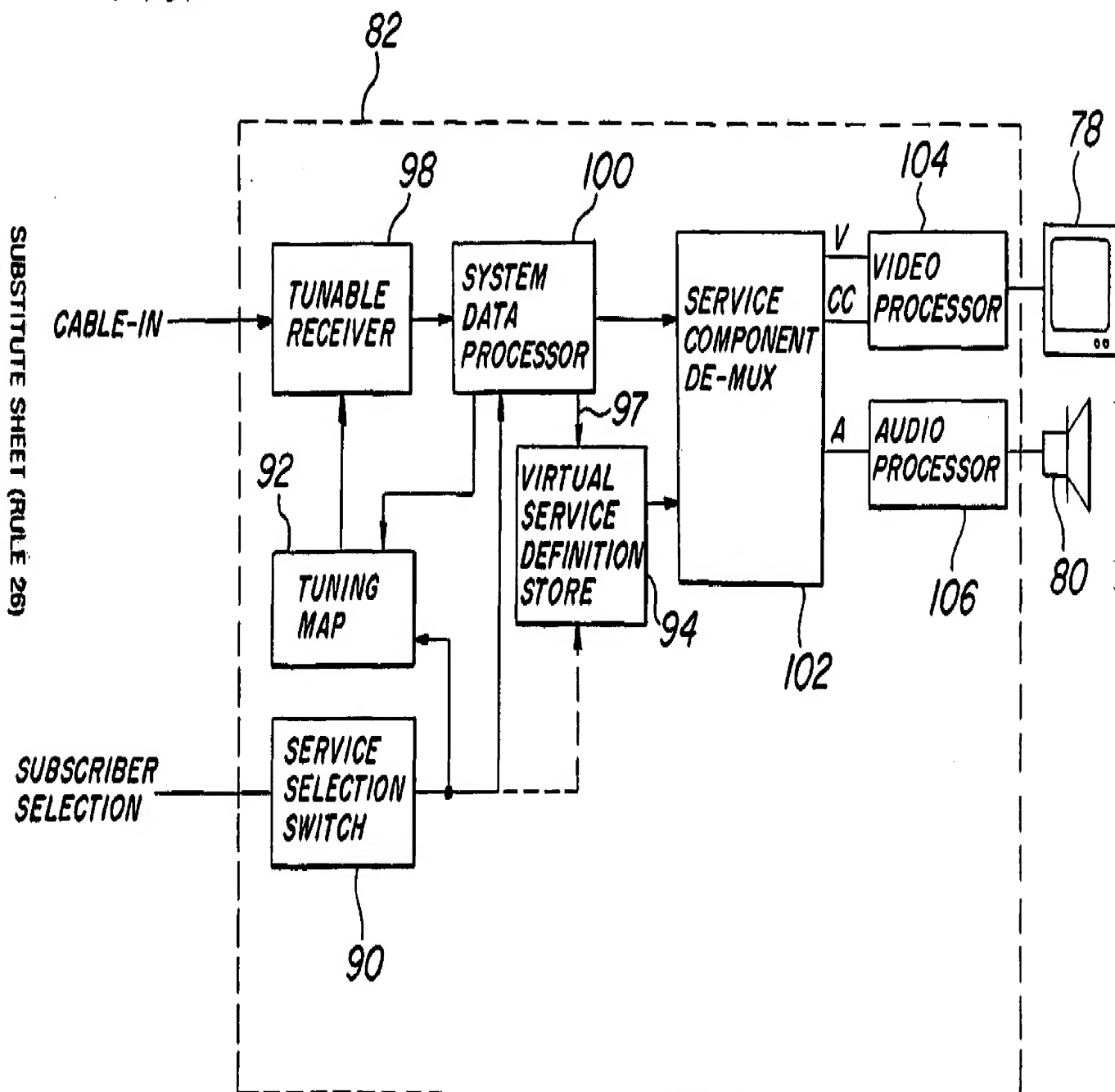
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**FIG. 5****FIG. 7**

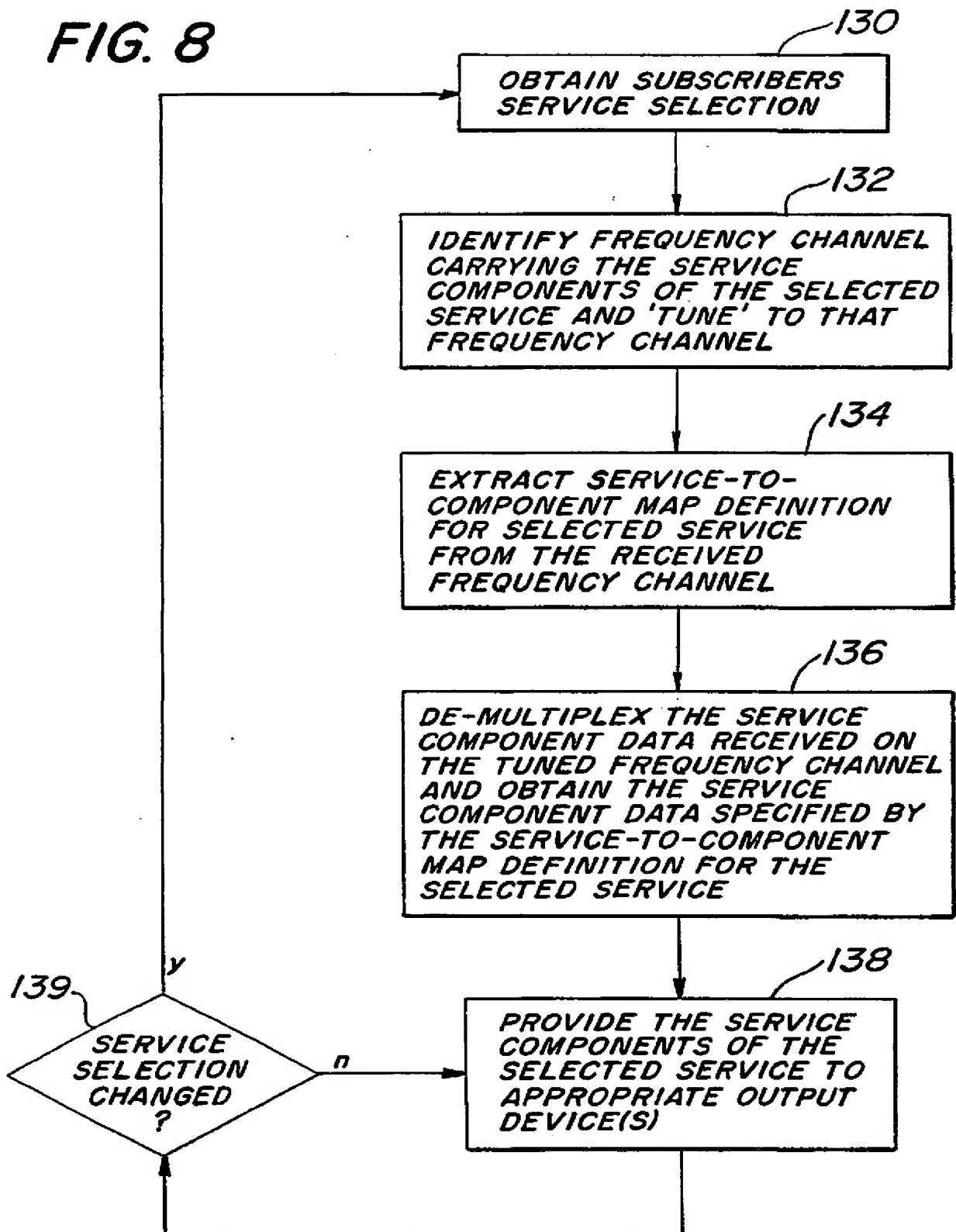
<b>VIRTUAL SERVICE NUMBER</b>	<b>FREQUENCY</b>	92
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2	$f_1$	
3	$f_3$	
4	$f_2$	
⋮	⋮	
24	$f_2$	
⋮	⋮	
30	$f_3$	
31	$f_8$	
32	$f_8$	
⋮	⋮	

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FIG. 6

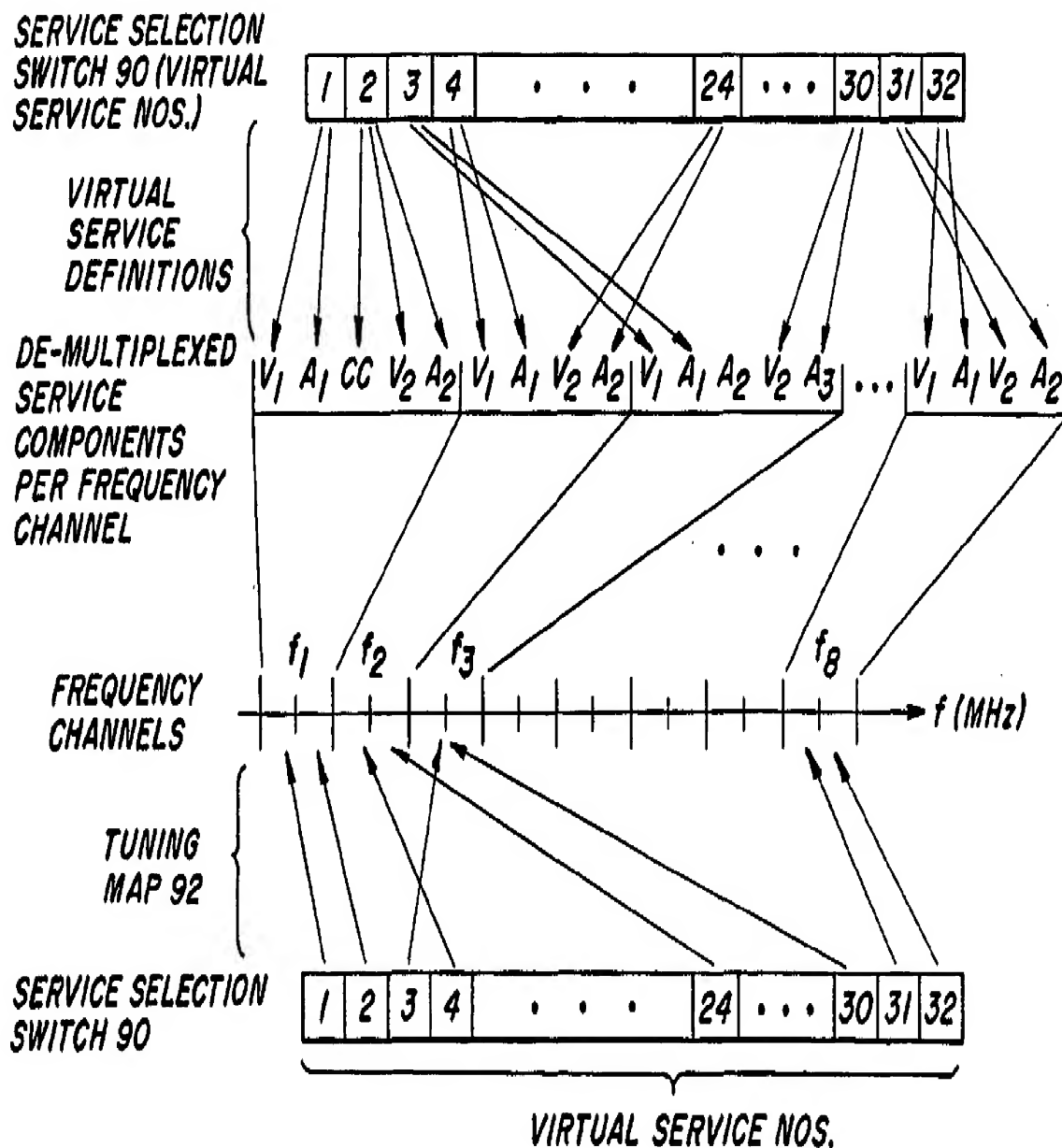


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**FIG. 8**

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FIG. 9

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/US95/00240

**A. CLASSIFICATION OF SUBJECT MATTER**

IPC(6) : H04H 1/08

US CL : 370/073,071,072,060, 094.100; 348/006,007,008,213

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 370/073,071,072,060, 094.100; 348/006,007,008,213

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

NONE

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

NONE

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US, A, 4,935,924 (BAXTER) 19 June 1990, col. 1-4.	1-11

☐ Further documents are listed in the continuation of Box C.☐ See patent family annex.

* Special categories of cited documents:	* T later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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* E earlier document published on or after the international filing date	* Y document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
* L document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	* & document member of the same patent family
* O document referring to an oral disclosure, use, exhibition or other means	
* P document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search

22 FEBRUARY 1995

Date of mailing of the international search report

05 JUN 1995

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